

## What is claimed is:

**[Claim 1]** An apparatus for manipulating the temperature of a sample used in focused ion beam FIB processing, comprising:

a base member;

a thermoelectric module disposed over the base member; and

a sample mounted on a mounting surface of the thermoelectric module;

wherein said thermoelectric module is configured so as to reduce the temperature of said sample with respect to an ambient FIB tool temperature.

**[Claim 2]** The apparatus of claim 1, wherein said thermoelectric module further comprises a Peltier device.

**[Claim 3]** The apparatus of claim 2, wherein said thermoelectric module is configured to draw heat from the sample and exhaust said heat through said base member.

**[Claim 4]** The apparatus of claim 1, wherein said thermoelectric module is electrically coupled to a current source through an electrical connector disposed through a vacuum chamber wall of an FIB tool.

**[Claim 5]** The apparatus of claim 1, further comprising a thermal ballast module mounted on said base member.

**[Claim 6]** The apparatus of claim 5, wherein said thermal ballast module is disposed adjacent to said thermoelectric module.

**[Claim 7]** The apparatus of claim 5, wherein said thermoelectric module is mounted on said thermal ballast module.

**[Claim 8]** The apparatus of claim 5, wherein said thermal ballast module further comprises:

a sealed, hollow vessel constructed from a material having a high thermal conductivity; and

a plurality of internal fins configured for facilitating heat transfer from said base member to an internal ballast material, said internal ballast material including a high heat-capacity material.

**[Claim 9]** The apparatus of claim 4, further comprising a plurality of cooling ports within said base member, said cooling ports for receiving a cooling medium circulated therethrough supplied by a cooling supply line.

**[Claim 10]** The apparatus of claim 9, wherein said cooling supply line is coupled to a cooling medium connector disposed through a vacuum chamber wall of an FIB tool.

**[Claim 11]** A method for implementing focused ion beam (FIB) processing, the method comprising:  
mounting a sample on a mounting surface of an FIB tool, said mounting surface including a thermoelectric element;  
controlling said thermoelectric element so as to reduce the temperature of said sample with respect to an ambient FIB tool temperature; and  
applying an FIB to said sample.

**[Claim 12]** The method of claim 11, wherein said thermoelectric element further comprises a Peltier device.

**[Claim 13]** The method of claim 11, further comprising utilizing said FIB to deposit a layer on said sample.

**[Claim 14]** The method of claim 13, wherein said layer comprises an insulating layer deposited using a silicon-bearing precursor.

**[Claim 15]** The method of claim 14, wherein said insulating layer comprises  $\text{SiO}_2$ .

**[Claim 16]** The method of claim 13, wherein said layer comprises an insulating layer deposited using at least one or more of the following precursor combinations: tetramethylcyclotetrasiloxane (TMCTS) with no oxidizing agent, tetraethylorthosilicate (TEOS) with  $\text{O}_2$ , TMCTS with  $\text{H}_2\text{O}$ , TEOS with  $\text{O}_2$ , TEOS with  $\text{O}_2$ , TEOS with  $\text{H}_2\text{O}$ .

**[Claim 17]** The method of claim 13, wherein said layer comprises a metal layer deposited using at least one or more of the following precursor combinations: tungsten hexacarbonyl ( $\text{W}(\text{CO})_6$ ), methylcyclopentadienyl (trimethyl) platinum (V), any of the beta-diketonate copper (II) complexes, and any of the Lewis-base copper (I) beta-diketonate complexes.

**[Claim 18]** The method of claim 11, further comprising utilizing said FIB in a removal process to remove material from said sample.

**[Claim 19]** The method of claim 18, wherein said removal process further comprises at least one of: milling silicon using a xenon difluoride (XeF<sub>2</sub>) precursor, milling SiO<sub>2</sub> using an XeF<sub>2</sub> precursor, milling tungsten using an XeF<sub>2</sub> precursor, milling SiCOH type low-k dielectric materials using an XeF<sub>2</sub> precursor, milling chromium using an XeF<sub>2</sub> precursor, milling organic materials and polymers using an XeF<sub>2</sub> precursor, milling copper using an XeF<sub>2</sub> precursor, milling silicon using a Br<sub>2</sub> precursor, and milling aluminum using a Br<sub>2</sub> precursor.